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Neighborhood Environment and Self-Rated Health in Mainland China, Japan and South Korea

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NEIGHBORHOOD ENVIRONMENT AND SELF-RATED HEALTH IN MAINLAND CHINA, JAPAN AND SOUTH KOREA

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ABSTRACT

Neighborhood environments are considered crucial factors in affecting self-rated health. Previous empirical research has documented a positive association between self ratings of neighborhood environments and health status. Although this relationship has been studied extensively in western countries, the relationship between neighborhood ratings and health status in East Asian countries has received far less attention by researchers. Using data from the East Asian Social Survey 2010, this thesis examines the relationship between self-rated health and the three main types of neighborhood environment (built, physical, and social) in Mainland China, Japan, and South Korea. This study also compares the neighborhood effects on self-rated health across the three countries. Using logistic ordinal regression, this study found that neighborhood built, physical and social environments are positively associated with self-rated health in China, Japan and South Korea. And these effects vary by country, with the strongest association between neighborhood built physical and social environments and self-rated health in Japan.

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TABLE OF CONTENTS

Page

Table of Contents (Continued)

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

INTRODUCTION

Neighborhood environments are considered crucial factors in affecting self-rated health. Previous empirical research has documented a positive association between self ratings of neighborhood environments and health status. That is, people who rate their neighborhood environment relatively high tend also to report better health for themselves. This relationship has been extensively studied in western countries (Roh et al. 2011; Subramanian et al. 2006; Wen et al. 2006; Hill, Ross, and Angel 2005; Patel et al. 2003; Ellen, Mijanovich, and Dillman 2001; Hochheiser, Woodward, and Charney 1971). Previous research documented that socioeconomically disadvantaged neighborhoods are more likely to have poor air and water quality, poor housing quality, and fewer recreational outlets than relatively more advantaged neighborhoods (Patel et al. 2003; Ross and Mirowsky 2001). Deteriorating tax bases in poor neighborhoods also can compromise municipal services, such as transportation, sanitation, and fire departments. At the same time, access to health care and quality of services are usually compromised in poor neighborhoods. Poor neighborhoods also have relatively high rates of crime and violence. According to Sampson et al. (1997), these higher rates are a result of lower levels of collective efficacy of neighborhoods. Thus, people who live in a socioeconomically disadvantaged neighborhood are more likely to be exposed to an unhealthy environment than are those who live in relatively more advantaged neighborhoods.

Although similar studies related to neighborhood environment and self-rated health have already been done in one country in East Asia (Fujino et al. 2011; Wen et al.

2010; Bassani 2008), comparison across countries has received far less attention. In the past few decades, many East Asian countries have experienced rapid industrialization. This rapid industrialization has been associated with increased life expectancy and living standards (Hanibuchi, Nakaya, and Murata 2012; Bassani 2008). Previous research showed that, with higher life expectancy and living standards, people tend to care about their health more and spend more on their health care (Breyer and Felder 2006; Lubitz 2003). It is especially so in Mainland China, Japan, and South Korea due to their influential status in East Asia. This has provided a unique setting to test their population's health status and its various determinants.

Previous research suggests that income, education, and occupational status have strong associations with self-rated health in western countries (Wu et al. 2014; Alvarez-Galvez et al. 2013; Galea and Ahern 2006; Stjarne et al. 2006; Hill, Ross, and Angel 2005; Ellen, Mijanovich, and Dillman 2001; Hochheiser, Woodward, and Charney 1971), and class identification plays an important role in determining health status in East Asia (Hanibuchi et al. 2012). However, only limited analyses have been undertaken on self-rated health and its determinants beyond socioeconomic context. Therefore, this thesis will be used to provide guidance for investigating more of the social determinants of health. It is anticipated that findings from this study will contribute to the body of empirical research on the linkages between self-rated health and neighborhood environments. As more and more physical and social determinants of health are properly understood by the general public, many health problems will be effectively avoided. Thus the population's health will also be improved. Most importantly, studying the effects of neighborhood environment on self-rated health in a cross-national context, will not only give us a better sense about more causes of social inequality in health other than socioeconomic characteristics, but also could aid policy makers in China, Japan and South Korea to make more effective policies to reduce possible adverse effects of neighborhood effect on population's health.

This thesis examines the relationship between self-rated health and three types of neighborhood environments in eastern countries. These types are the built environment, the physical environment, and the social environment. Neighborhood environment effects on health will be compared across China, Japan and South Korea. Using the East Asian Social Survey (EASS) from 2010, which is a biennial social survey project that serves as a cross-national network of four General Social Surveys in East Asia, we can examine how built, physical and social neighborhood environments influence self-rated health at the individual level, and compare these effects in a cross-national context.

LITERATURE REVIEW

Neighborhood Environment and Its Dimensions

In the literature on urban planning and public health, neighborhood environment is a widely used and important term. To better understand this concept, the definition of 'neighborhood' needs to be reviewed and discussed. In an article published by Galster (2001), neighborhood was described as the following: "An existence that urban social researchers have treated in much the same way as courts of law have treated the pornography, a term that is hard to define precisely, but everyone knows it when they see it" (2001:2112). Because "neighborhood" is such a vague, and hard-to-define concept, explicit definitions are seldom seen in social research. Its spatial definition is usually used when a definition for neighborhood is needed. Therefore, social scientists usually rely on geographic boundaries to define neighborhoods in many studies (Coulton 2012; Diez Roux 2008).

Examples can be found in a study from Flowerdew et al. (2008), which used British Census Enumeration Districts as building blocks to construct alternative zonal systems. In this study, the authors experimented to see whether neighborhoods defined in different ways have similar implications for health. It was concluded that neighborhoods should be examined using several different factors, and that the size and composition of these neighborhoods may be different in different parts of a study area.

In terms of neighborhood, Park (1916) conducted a study that defined neighborhoods as the "natural areas" developed through the competition between businesses and residential groups seeking affordable housing. According to him, a neighborhood is a subsection of a larger community. More specifically, it is a collection of institutions and people that occupy a spatially defined area influenced by cultural, political, and ecological forces (Park 1916). However, spatial definition only partially defines the neighborhood, which leaves the rest to other possible definitions that are much deeper and complex. This view was further refined by Suttles (1972) by stating that, neighborhoods should be thought of not only as the distinct areas of a city, but also a hierarchy of ecological groupings at four levels: the local network (usually formed by a group of residents who share the same local facilities and residential condition because of their proximity to each other), the defending neighborhood (referred as the smallest area that has a corporate identity recognized by both its insiders and outsiders), the community of limited liability (imposed by external commercial or governmental interests), and the expanded community of limited liability (large-scale neighborhoods which arise from government policies or programs). We can think of neighborhoods at this point as ecological units that exist in successively larger communities.

Influenced by previous research (Suttles 1972; Park 1916), the neighborhood as defined in EASS 2010 considered both geographic boundaries and hierarchy of ecological groupings. All data were collected based on the neighborhood conditions of 1 kilometer (0.6 miles) around respondents' home, or approximately 15 minutes on foot. This inclusive criterion not only provides a geographic sense of the neighborhoods, but also indicates the neighborhood range which could influence the respondents most (as compared to larger communities, such as towns and cities).

Similar to the definition of "neighborhood", neighborhood environment is also defined based on geographic boundaries and hierarchy of ecological groupings in the literature (Saelens et al. 2003). In the research of western health, the neighborhood environment refers to a person's immediate residential environment, which is hypothesized to have material and social characteristics that could influence people's health outcomes the most (Diez Roux 2001). This range typically refers to an area within 0.5 miles of the participant's home, which is very similar to the neighborhood range defined by EASS 2010. Therefore, empirical findings from western countries related to this topic, to some extent, could be very useful references for studying neighborhood effects on health in East Asia.

Guided by this definition, researchers further categorized neighborhood characteristics as either objective or subjective (Wen, Hawkely, and Cacioppo 2006; Feldman and Steptoe 2004; Stafford and Marmot 2003). According to them, objective neighborhood characteristics refer to region-level indicators which are independent of an individual's own perception. For example, median income and unemployment rate. The subjective neighborhood characteristics refer to the individual-level perceptions of the neighborhood characteristics in a wide range of domains. For example, perceived safety level of a neighborhood, social cohesion, and access to particular services such as hospital and church.

Relying on the census data, aggregated by block groups, census tracts and postal codes, many studies have demonstrated that objective neighborhood socioeconomic conditions are strongly associated with health outcomes (Cummins et al. 2007; Diez-Roux 2001; Robert 1999). In addition to objective neighborhood characteristics, other researchers found that subjective neighborhood characteristics could also have strong associations with health status. For example, people who reported that their neighborhoods have more access to public services and lower crime rates perceived a better health than those who have less access to public services and higher crime rate (Cummins et al. 2007; Cummins et al. 2005; Macintyre, Ellaway, and Cummins 2002).

Examples also could be found in many other relevant studies in recent years on this topic. A study conducted by Weden et al. (2008) examined both objective and subjective assessments of neighborhood conditions, and they explored the overlap between different sources of information on neighborhoods and the relative strength of their association with self-rated health among adults. The results showed that subjective and objective conditions were both related to health. However, the subjective aspect (perceived neighborhood quality) was not only strongly associated with health, but also could mediate associations between health and the objective aspects (neighborhood disadvantage and affluence). One contribution of this study is that it highlighted the particularly strong association between perceived neighborhood quality and health.

Sallis et al. (2009) categorized the neighborhood environment into three other different dimensions. These dimensions are the built environment, the physical environment, and the social environment. Built environment refers to the space, where people live, work, and play each day. It consists of neighborhood roads, buildings, food sources, and other recreational facilities. It affects many daily decisions, such as whether to walk to work or school, to eat frequently at fast food restaurants, or to take children to parks. All of these decisions partially depend on how the neighborhoods are built. Physical environment refers to the objective characteristics of contexts where people live. Examples of this include homes, neighborhoods, and schools. It includes aspects of urban design and environmental conditions (Bowling and Stafford 2007). Social environment refers to the immediate physical surroundings and social relationships, as well as cultural milieus within which defined groups of people live and interact. These dimensions categorize neighborhood environment in a more comprehensive way than treating neighborhood environment as a single construct.

The Effects of Neighborhood Environment on Health

During the past few decades, there has been an increasing interest in the effects of neighborhood environments on public health (Mathis, Rooks, and Kruger 2015; Subramanian et al. 2006). This interest in the social determinants of health, to a great extent, was inspired by many empirical contributions in the past 15 years (O'Campo 2003; Sampson and Morenoff 2002; Diez-Roux 2001). These studies showed that the impacts of neighborhood characteristics, independent of individual factors, exist across a wide range of public health outcomes, such as cardiovascular mortality, infant and youth health, chronic diseases, and mental health. Whether the neighborhoods have better and more access to hospitals and clinics and whether neighbors have mutual trust also influence the physical and mental health of adults and children. This has provided a solid basis to conclude that neighborhood environments really matter for health.

Collective efficacy theory was rooted in the relationship between neighborhood effects and health (Teig et al. 2009; Cohen, Inagami, and Finch 2008; Cohen et al. 2006; Browning and Cagney 2002). Previous researchers have defined collective efficacy as the process of activating or converting social ties among neighborhood residents in order to achieve collective goals, such as public order or the control of crime (Sampson, Raudenbush and Earls 1997; Bandura 1986). On the basis of the previous studies, collective efficacy in this study is defined as the linkage between neighbors' mutual trust and a commonly shared willingness to intervene for the common good of the neighborhood.

In collective efficacy theory, there are two main components, including social cohesion and informal social control (Teig et al. 2009). Social cohesion normally results from solidarity and mutual trust, and informal social control is usually defined as fulfilling neighbors' expectations of being able to take actions together. In other words, neighborhood environments where people feel connected to each other also tend to be environments where they feel that they should take action together. However, collective efficacy and its two components, social cohesion and informal social control, are usually negatively associated with not only crime rate (Sampson et al. 1997), but also with obesity and risky sexual behavior (Cohen et al. 2006), which may directly lead to negative health outcomes. Findings from these studies suggest that collective efficacy may also affect people in other more generalized ways besides its regulatory functions, including possibly compromising one's health.

There are several possible reasons that collective efficacy may contribute to health status, including the social control of health-compromising behaviors, access to services and amenities, and the management of neighborhood physical hazards (Kawachi and Berkman 2000; House, Landis, and Umberson 1988). First of all, the regulatory effect of collective efficacy on violence, a phenomenon with direct implications for health, is proposed by a previous study (Sampson et al. 1997). Risky and problem behaviors (such as substance abuse, child abuse and reckless behavior) may be subject to the efforts of collective social control. Second, neighborhoods with higher levels of collective efficacy may be more effective at attracting and maintaining health and education services than those neighborhoods with lower collective efficacy. For example, health clinics, pharmacies and schools. Third, many physical hazards in the community, such as decaying community infrastructure (poorly maintained streets) and housing stock (dilapidated or abandoned buildings) could also have negative effects on the community. These risks could be more effectively reduced in the neighborhoods with high collective efficacy through the solicitation of external resources to correct potentially risky conditions and through rigorous monitoring of neighborhood hazards and vulnerable residents, such as the elderly or disabled. Therefore, collective efficacy is usually used as the theoretical model when studying the effects of neighborhood environments on public health.

In recent years, there have been an increasing number of studies that build off the previous research to examine the effects of neighborhood environments on health. Some of them have shown that built environments are strongly associated with self-rated health. For example, a study conducted by Doyle et al. (2006) examined the relationship between walkable and safe communities and self-rated health status. According to them, people who live in neighborhoods that are more walkable and have lower crime rates tended to walk more and to have lower body mass indices (BMIs) than people in less walkable and high crime rates areas, even after controlling for a variety of individual variables related to health. Among lifelong residents of an area, less walkability and more crime are also associated with weight-related chronic illness. This effect is stronger for women than for men. This article suggests that, in order to promote activity and health, planners should consider community walkability, crime prevention, and safety. Another study conducted by Mujahid et al. (2008) also had similar conclusion.

Physical environment can also be a crucial determinant for self-rated health. A study conducted by Wen and Gu (2012) found that air pollution can shorten population's life expectancy and health expectancy for older adults in China. This effect is more serious for women than for men. Their study is a multilevel prospective cohort study based on a nationally representative sample of Chinese elders. However, with a relatively short follow-up period (3 years), it is difficult for this study to detect longer-term pollution effects. Another study conducted by Ellen, Mijanovich and Dillman (2001) indicated that neighborhood physical environment can affect self-rated health through polluting factories and toxic waste sites. This significantly increases the chances for people to contract cancer and other diseases.

Aside from built and physical environments, social environments can also influence self-rated health. Social environments include people's mutual trust and social support in the neighborhood. According to Sirgy and Cornwell (2002), satisfaction with neighborhood social environment features plays a crucial role in satisfaction with life and health status. Yen and Syme's research (1999) also showed that social environments are associated with health problems and even mortality risks. Another study conducted by Beckett et al. (2002) had a similar conclusion. Using a longitudinal survey of elderly Taiwanese, this study examined the linkages among health, the social environment, and exposure to life challenges. The results showed that poor health status is associated with (1) low socioeconomic status, not having any living children, limited networks of friends, and low participation in social activities; and (2) three specific life challenges: chronic financial problems, excessive demands placed by close relatives and friends, and having a spouse in poor health. Beckett et al. further concluded that respondents facing several challenges or having multiple negative attributes in their social environment are especially likely to be unhealthy compared with their more advanced counterpart.

Relevant examples can also be found in Cummins's study (2005), which was conducted in Scotland and England. Aiming to investigate associations between measures of neighborhood social and material environments and self-rated health, this study found that fair to very poor self-rated health is significantly associated with the following neighborhood attributes: poor quality physical residential environment, low political engagement, high unemployment, lower access to private transport, and lower transport wealth (cars value), even after controlling for sex, age, and social class. These results may stem from at least three causes. First, poorer quality neighborhood environments may restrict residents from adequate opportunities for physical exercise, such as walking and playing sports, which have direct effects on health. Second, low political engagement (as measured by voter turnout, for example) can represent marginalization, social disenfranchisement, and lack of trust in political powers to bring good changes to the local area, which may directly affect psychological well being. Third, high unemployment and low access to private transport are both markers of people's income. The negative association between income and health status has already been established by previous research (Deaton and Paxson 1998; Ettner 1996).

Examples of previous research about the effects of neighborhood environments on health can also be found in Poortinga, Dunstan and Fone's work (2007). In this study, the authors were aiming to examine whether a neighborhood's access to amenities, neighborhood quality, neighborhood disorder, and neighborhood cohesion are associated with people's self-rated health. Using data from the cross-sectional Caerphilly Health and Social Needs Survey, this study found that poor access to amenities, poor neighborhood quality, neighborhood disorder, and lack of social cohesion are positively associated with poor self-rated health. This study provides further evidence that neighborhood environment is associated with self-rated health, and it confirms previous researchers' findings that the existence of neighborhood problems, such as poor access to amenities, negatively affect health status. Besides these, many other researchers have reported similar findings (Prus 2011; Kamphuis et al. 2010; Collions, Hayes, and Oliver 2009; Hill, Ross, and Angel 2005; Ellen, Mijanovich, and Dillman 2001; Hochheiser, Woodward, and Charney 1971).

In empirical studies, the researchers usually rely on self-rated health as a measure of overall health. According to Cagney, Browing and Wen (2005), self-rated health has a better chance to reflect the impact of collective efficacy more readily than any other measures of health status due to its nature and the scope of questions. Also, self-rated health status is usually measured by asking questions related to physical energy, active functioning, and perceptions about social support. These domains are particularly responsive to environmental change. For example, if one person is afraid to walk outside, then his or her functioning well-being and energy can lessen to a great extent in a community context. According to Idler and Benyamini (1997), self-rated health can also capture the full array of disease that people have, and sometimes even symptoms relating to an undiagnosed illness. Considering all of these arguments, self-rated health will be used in this thesis as well.

Neighborhood Effects on Health in the East Asian Context

Even though neighborhood effects on health status have already been extensively studied in western countries, studies focusing on the same topic in eastern countries have been relatively few. People with similar characteristics but who live in different neighborhoods, cities, or even countries might have different self-rated health statuses due to different cultural, geographical, and historical influences (Merlo et al. 2005). Thus, conducting more studies focusing on the effects of neighborhood environments on health in East Asia becomes more necessary.

Mainland China, Japan and South Korea are three countries in East Asia that provide unique settings to test the effects of neighborhood environments on health. China has experienced several sweeping social, economic and cultural transformations since the beginning of the economic reforms in 1978. Along with economic growth and an increasing global influence, income inequality has also intensified. This has had the effect of further worsening inequalities in health, because access to a better lifestyle and medical care to a great extent depend on household income level (Yang 1999). Paralleling the rapid economic development and the increasing income disparity is the unprecedented rural-to-urban migration. Because urban areas have more job and educational opportunities, and better health care services, more and more people are moving from rural to urban areas to seek better lives. This further amplifies the spatial inequality between rural and urban areas. The one-child policy, which was launched in 1979 to control the national fertility rate, also plays a unique role in affecting population's health status in China. Since the policy took effect more than 30 years ago, population growth has slowed significantly. This contributed two decades of spectacular economic development in China. As this policy is carried forward, Chinese families are much smaller than they were 40 years ago. Therefore, the average living standard would be further improved with the same level of family income, and this ultimately influences population's health status. Evidence related to this situation can be found in Ding and Hesketh's study (2006), which indicated that smaller families are associated with a higher level of education and living standard in China today. It is anticipated that these specific characteristics will play a unique role in the association between the effects of neighborhood environments and self-rated health in China.

As discussed previously, neighborhood environment effects on health status in China has been extensively studied before. For example, Wen and Gu (2012) pointed out that air pollution has a devastating health impact on the Chinese population. Increased exposure to outdoor air pollution also corresponded to worse health, which indicates a positive association between physical environment and self-rated health in China. Another study (Wen et al. 2010) showed that neighborhood satisfaction, social cohesion and safety are also strongly associated with self-rated health among Chinese respondents, which shows a positive association between social environment and self-rated health in China.

As developed Asian countries, Japan and South Korea also have different contexts compared to western countries when studying neighborhood effects on health. After World War II, both Japan and South Korea have achieved rapid industrialization as a result of strong government interventions (Kim and Maeda 2001; Diebold and Alice

1990; Johnson 1982), which makes them comparable to western countries to some extent. However, they may still require more time to catch up with western countries in economic development. Both Japan and South Korea are aging countries with population densities almost ten times greater than the United States (Bassani 2008; Lee and Shinkai 2003), which makes their built environments very different from those of western countries. For example, high population density countries in East Asia usually have a built environment characterized by a well-developed commercial area with good access to public transit (Sun et al. 2009), which is quite different from typical western countries in that shops and services may still exist within residential neighborhoods, but train stations are usually present and often used by commuters.

A study conducted by Iwase et al. (2012) pointed out that most previous studies focusing on the effects of neighborhood environments on self-rated health in western countries, especially in the United States, have defined neighborhood environment factors on the basis of race and/or ethnicity, but there is no point in using race or ethnicity as a control variable in East Asian countries since the vast majority of people are of one race or ethnicity. For example, over 95% of the population in Japan and South Korea are defined as 'Japanese' or 'Korean'. This is a major difference between western and eastern settings when investigating the effects of neighborhood environments on self-rated health because of the greater ethnic and cultural diversity of western countries. Since there are big differences between eastern and western cultures, other factors related to social environment could likely vary as well, such as social capital and social cohesion. All of these differences in neighborhood setting are likely to result in different health statuses between western and eastern countries. Since very few studies compared these three countries (Mainland China, Japan and South Korea) on the relationship between neighborhood environments and health, this thesis can make an important contribution to the literature.

HYPOTHESES

Neighborhood environment can be categorized into three types, which are built, physical and social environments. They can be particularly strong determinants in affecting people's health statuses (Sallis et al. 2009; Larsen and Merlo 2005). Physical activity can effectively reduce adverse health outcomes and prevent obesity in the general population (Sun, Lin, and Li 2012; Miles 2007; Pate et al., 1995). To some extent, physical activity level depends on how a neighborhood is built. Aside from physical activity, built environments could also influence other daily decisions, such as whether or not to eat frequently in fast food restaurants, or to take children to faraway parks if there are no parks in their neighborhoods. High frequency of eating in fast food restaurants might negatively affect neighborhood's collective efficacy and people's health as it encourages eating high calorie foods on the go, and discourages the slower cooking and meal times when people could not only eat together, but also interact with each other about their feelings and lives (Putnam 2000). Parks that designed as places to relax, exercise, experience nature, socialize and have other celebration activities, might positively affect neighborhood's collective efficacy and people's health as they not only evoke positive images that might facilitate interpersonal interactions, but also could promote people's health by playing sports and walking in parks (Cohen, Inagami, and

Finch 2008). Different choices can result in different health outcomes. Also, according to previous research that have been done on health and built environments, people are usually physically and mentally healthier in neighborhoods with healthier food choices, and with more sports and recreational facilities (Auchincloss et al. 2007; Saelens et al. 2003). On the other hand, greater perceptions of built environment problems in neighborhoods result in a lower quality of life, deteriorating physical functioning or even many specific disease outcomes (Yen et al. 2006). So there are reasons to believe that the built environment is associated with people's health status.

H1: The quality of the neighborhood built environment is positively associated with self-rated health status in China, Japan and South Korea.

The second hypothesis in this study focuses on how physical environment affects self-rated health. According to Davison and Lawson (2006), physical environment refers to the objective characteristics in the contexts where people live; for example, homes, neighborhoods and schools. It includes aspects of urban designs (neighborhood structure design, streets, sidewalks, for example) and environmental conditions (air and water quality). Compared to urban design, environmental conditions usually have more powerful and psychological health-related consequences for people (Kaplan and Peterson 1993). Thus, this study focuses on particularly the air, water and noise pollution of neighborhoods as physical environment indicators for self-rated health. In Ellen, Mijanovich and Dillman's work (2001), they indicated that the neighborhood physical environment affects self-rated health through polluting factories and toxic waste sites. This significantly increases the chance for people to contract cancer and other diseases.

There are also many other studies related to pollution and self-rated health in East Asia. For example, Wen and Gu (2012) found that air pollution has a devastating health impact on the Chinese elder population reducing longevity and health expectations. Shima, Nitta, and Adachi (2003) found that air pollutants, such as automobile exhaust, is a major causal factor for people who have asthma in Japan. Imamura, Ide and Yasunaga (2007) also had the similar finding. On the other hand, in a neighborhood that is clean and less polluted, people might be more apt to walk outside, feel friendly and trust each other, which might directly or indirectly enhance neighborhood's collective efficacy and promote people's health. Thus, we also assume a positive relationship between neighborhood physical environment and self-rated health. The second hypothesis is:

H2: The quality of the neighborhood physical environment is positively associated with self-rated health status in China, Japan and South Korea.

The third hypothesis in this study focuses on how social environment affects self-rated health, including social networks, neighborhood safety and social support. They are quite decent measures that could reflect neighborhood's collective efficacy and influence people's health. For example, in a neighborhood that is safer and where people mutually trust and help each other, people tend to be more likely to feel that they should take action together for their collective goals. Previous research has also shown that people who have more extensive and strong social connections are usually report better health than those who are less socially integrated (House, Landis, and Umberson 1988). Yen and Syme (1999) also found that social environment is associated with health problems and even mortality risks. Other evidence can also be found in many other studies

(Goldman, Korenman, and Weinstein 1995; Shye et al. 1995), which shows the significant effects of social ties and social support on self-rated health. These findings all suggest that the social environment could influence people's health. Hence the third hypothesis in this study is:

H3: The quality of the neighborhood social environment is positively associated with self-rated health status in China, Japan and South Korea.

The fourth hypothesis is concerned with the comparison of the built environment's effects on health status in China, Japan and South Korea. In the past few decades, as a developing country, China has achieved rapid industrialization. At the same time, life expectancy and living standards have also increased. More people are more concerned about the quality of what they eat and where they live (Wang, Chai, and Li 2011). Therefore, the built environment in China becomes more crucial when its population considers their health status. However, as developed countries affected by western cultures for decades, Japan and South Korea have a relatively long history of economic development and raising their populations' living standards. Therefore, the built environment very possibly has stronger influences on population's health status in Japan and South Korea compared to China. Thus, we expect some variation in the effect of built environment on self-rated health between these countries, but we leave it to the empirical test to inform us about how they vary. So the fourth hypothesis is:

H4: The relationship between the neighborhood built environment and self-rated health varies among China, Japan and South Korea.

The fifth hypothesis focuses on the comparison of the health effects of physical environment between China, Japan and South Korea. As a result of incredible economic growth, China is faced with an unprecedented environmental threat as a trade-off for its developing economy, especially air and water pollution, which have become two of the major sources of morbidity and mortality in China. As China increasingly contributes to global economic growth, the country also potentially becomes one of the largest polluters in the world (Yu 2008:69), which raises a coherent sense of generalized environmental concern among Chinese citizens (Xiao, Dunlap, and Hong 2013). This concern is especially serious among those who are more educated, males, residents of large Chinese cities, and government employees. Serious air pollution also increases the risk of lung cancer among Chinese population. Previous research showed that lung cancer is a serious health problem in China, as in the rest of the world (Zhao et al. 2006). Tie, Wu and Brasseur (2009) also stated that air pollution provides a considerable risk for respiratory morbidity, cardio-pulmonary mortality and the incident of lung cancer. This particular situation may amplify the physical environment effects on the Chinese population's health status. Since Japan and South Korea have different geographic, political, and historical contexts than China, the situation may vary for these two countries. As two developed countries, Japan and South Korea are deeply influenced by western countries in developing more advanced pollution management strategies than those in China. However, natural disasters (such as earthquakes) and industrial accidents (such as nuclear accidents) complicate the situation more than previously supposed, especially in Japan. These damaging factors affect population's health status both physically and psychologically (Talesnik 2015). Thus, we expect some variation in the effect of physical environment on self-rated health between these countries. Also we leave it to the empirical test to inform us about how they vary. The fifth hypothesis is:

H5: The relationship between the neighborhood physical environment and self-rated health varies among China, Japan and South Korea.

Cramm et al. (2013) stated that social environments have a significant effect on self-rated health status, especially in aging countries. Other studies (Mathis, Rooks, and Kruger 2015; Yen, Michael, and Perdue 2009) showed that the effect of social environment on health is particularly salient among older adults. Vulnerable populations usually rely more on social support from neighborhoods. Poor neighborhood social environments, characterized by a lack of social support, social networks, social cohesion, and low perceptions of safety, may very likely lead to physical inactivity, obesity, and mental health disorders among this vulnerable population group. According to Park and Lee (2013), Japan and South Korea are both aging countries; however, Japan has a proportionately larger elder population (> 65 years old) than South Korea and China (Lee and Shinkai 2003). They also found that older Japanese who lend to or receive social support from others tend to rate their health status better than who are less involved in social support. Therefore, it is reasonable to expect that the association between the social environment and health status in Japan will be stronger than in China and South Korea. Therefore, the sixth hypothesis is:

H6: Compared to China and South Korea, the social environment in Japan will have a stronger effect on self-rated health status.

METHODOLOGY

Data

The East Asian Social Survey (EASS) of 2010, is the data source for this study. The EASS is a biennial social survey project that serves as a cross-national network of the following four General Social Surveys in East Asia: The Chinese General Social Survey (CGSS), the Japanese General Social Survey (JGSS), the Korean General Social Survey (KGSS), and the Taiwan Social Change Survey (TSCS). The current study focuses on data from China, Japan and South Korea. Taiwan is excluded because of too many missing cases. In terms of the relevant variables, researchers asked about the diverse aspects that affected people's overall health, such as specific conditions, physical functioning, aid received from family members or friends when needed, and lifestyle choices. More importantly, they provide most of their data in a cross-national context, which meets the basic requirement of this special case.

Because EASS 2010 serves as a cross-national network for General Social Surveys in East Asia, the target population for this study is quite large. It includes all Chinese residents who are 18 years old or older, all Japanese men and women who are 18 and over and currently living in Japan, and all South Koreans 18 years old and over, currently living in South Korea. In China, the three-stage probability proportional-to-size sampling produced an initial sample size of 5,370. The response rate was 71.99% (3,866 respondents). In Japan, a two-stage random sampling method, stratified by regional block and population size, was used in collecting the data. The initial sample size was 4,500 people. The response rate was 55.5% (2,496 respondents). In South Korea, a multi-stage area probability sampling method was used, and 2,500 people were initially sampled for the survey. The response rate was 63% (1,576 respondents), and the samples were further weighted to correct for survey design effects in the different countries. Since the data were collected prior to the Fukushima Daiichi nuclear accident in Japan, the possible influence of this disaster on people's perception of neighborhood environments cannot be assessed in this thesis though it may be an important issue for future research. In EASS 2010, there are missing cases in each country's data. Because the number of missing cases for the variables that I use in this study are not large, I delete them list wise, except for household income which will be explained further in the measurement section.

Measurement

Dependent Variable: Self-rated Health Status

In this study, self-rated health status is the dependent variable. Respondents were asked "In general, would you say your health is", with original response options ranging from 1=Excellent health status to 5= Poor health status in the dataset. In order to make it easier to interpret, they were reverse-coded into 1= Poor, 2= Fair, 3= Good, 4= Very good and 5= Excellent. "Do not know" here is treated as system missing.

Independent Variables

The first independent variable is perceived neighborhood built environment. The respondents were asked to what extent they agree or disagree with the following three statements: (i) "The neighborhood is suitable for doing exercise such as jogging or walking"; (ii) "A large selection of fresh fruits and/or vegetable is available in the neighborhood"; and (iii) "The neighborhood has adequate public facilities such as community centers, library, parks, etc." There were five response categories for the three questions: 1= Strongly agree, 2= Agree, 3= Neither agree nor disagree, 4= Disagree and 5= Strongly disagree. These variables were reverse-coded so that higher values are associated with better perceived neighborhood built environment. The second independent variable is the perceived neighborhood physical environment. This was derived from three questions asking the respondents how severe (i) the air, (ii) water, and (iii) noise pollution are in the area of their local residence. There were originally four categories for each question, 1= Very severe, 2= Somewhat severe, 3= Not so severe, 4= Not severe at all. The third independent variable is perceived neighborhood social environment. Respondents were also asked to what extent they agree or disagree with the following three statements: (i) "The neighbors are mutually concerned for each other", (ii) "The neighborhood is safe", and (iii) "Neighbors are willing to provide assistance when I am in need". The response categories are the same for the three questions, which include 1= Strongly Agree, 2= Agree, 3= Neither agree nor disagree, 4= Disagree and 5= Strongly disagree. These variables were reverse-coded so that higher values are associated with better perceived neighborhood social environment. "Do not know" for these questions is treated as missing data. The definition of neighborhood was given to the respondents before these questions were asked. The respondents were told that "neighborhood" is defined as the area 1 kilometer (0.6 miles) around respondent's residential area.

Because the three questions for each independent variable are highly correlated, they cannot be put in the regression models as different independent variables.

Combining these questions into a few indices is a standard solution. A factor analysis was first conducted before creating the new indices and the results are reported in Table 1. The results clearly identified three factors among the nine variables in the data as described above. Factor one refers to the physical environment and accounts for 25.5% of the total variance. Factor two refers to the social environment and accounts for 22.9% of the total variance. Factor three refers to the built environment and accounts for 20.5% of the variance. The neighborhood safety has a relative low loading value of .500. Since there is a conceptual basis for including neighborhood safety in the social environment index with variables related to neighborhood cohesion, and previous researchers included it in their indices (Mujahid et al. 2008; Wen and Christakis 2005), the social environment index used here will also include this item. However, two social environment indices, one including neighborhood safety and the other not including neighborhood safety, will be separately entered into regression models to test whether there will be any difference in the regression results. Table 2 reports results from reliability analysis of the three indices. The built environment index has a Cronbach's Alpha value of 0.632. Although 0.632 is slightly lower than 0.7, it is still an acceptable value. The physical environment index has a Cronbach's Alpha of 0.823 and the social environment index has a Cronbach's Alpha of 0.756, indicating good reliability. These three indices will be used as independent variables in the statistical analysis. Each index represents the average score of responses to the three indicators of a particular dimension of neighborhood environment.

(Table 1 about here)

(Table 2 about here)

Control Variables

The control variables include respondent's age, gender, marital status, years of schooling, household income, employment status and self-assessment of community type. This thesis examines how self-rated health is affected by perceived neighborhood environments after controlling for these social, economic and demographic markers. All control variables are used to remove confounding influences and reduce the chance of spurious inferences.

Among the seven control variables, age and years of schooling are treated as interval/ratio variables. They are used directly in the regression models without being recoded. The other five variables are either nominal or ordinal variables and they were all coded into dummy variables in regressions. Gender was coded into male, with female as the reference category. The six categories of marital status in the original data were combined and recoded into four categories (married, widowed, divorced, and never married); never married is the reference category. For respondent's employment status, there are originally two categories, full time and part time, with more than 500 missing cases for each country caused by the skip pattern of the previous question regarding employment status in the original survey. The recoded employment status variable has three categories: full time, part time, and not working, with not working as the reference category. The self-assessment of community type variable originally has five categories: a big city, the suburbs or outskirts of a big city, a town or a small city, a country village, and a farm or home in the countryside. The first three refers to cities and the last two are village and farm. Therefore, the first three categories were combined to indicate urban residency and the last two were combined to represent rural residency, with rural as the reference category.

The household income variables are originally interval/ratio or ordinal variables, and are included in the dataset as separate variables for each country. Considering the socioeconomic and currency differences in the three countries, household income for each country was recoded into four categories according to the four quartiles: below 25%, 25%-49%, 50%-74%, 75%-100%, and a missing value category, with household income below 25% as the reference category.

Statistical Analysis

Univariate analyses were conducted, which reported unweighted and weighted descriptive statistics such as Frequency, Percentage, Mean and Standard Deviation for each variable in each country. Analyses were also conducted to test country differences in all the variables, The Kruskal-Wallis test was used for self-rated health status, built, physical, and social environments, age and years of schooling. The Chi-square test was used for gender, self assessment of community type, marital status and employment status. Since household income includes missing value category, a Chi-square test was also conducted for household income. In order to check for possible multicollinearity, bivariate correlations among dependent, independent and control variables were also conducted.

Four ordinal regression models were estimated for each country, which examine whether neighborhood built, physical and social environments could separately or jointly affect self-rated health status. These results were weighted so that the findings can be generalized to all adults in China, Japan and South Korea. In model 1, 2, and 3, each of the three independent variables, controlling for respondent's age, gender, marital status, years of schooling, household income, employment status and self assessment of community type, was entered separately in the regression model for each country. In model 4, the three independent variables were added into the model together to examine whether each of the three neighborhood environments is still significant in predicting self-rated health, when controlling for other two types of neighborhood environment and all the socioeconomic and demographic variables.

Apart from these models, another four models were estimated to test whether there are any interaction effects between country and the three neighborhood environment variables. By doing this, it can be determined whether the associations between neighborhood environments and self-rated health significantly differ by country. In other words, these four models examine whether these neighborhood environments are more influential in any specific country in predicting respondent's self-rated health than the other two countries. Two dummy variables representing China and South Korea and the interactions between these two country dummy variables and each of the neighborhood environment indices will be included in these models, with Japan as the reference category. The first three models examine each neighborhood environment index separately and the fourth model includes all three indices.

RESULTS

Descriptive Statistics

Table 3 shows the descriptive statistics for each variable in this study. Overall, a large majority of respondents reported good, very good or excellent health status. In China, a higher proportion of respondents rated their health status as very good, which accounts for 34.2% of all valid respondents in this study after weighting; 3.7% respondents reported their health statuses as poor, 13.3% reported fair health, 23.0% reported their health statuses as good, and 25.8% rated their health as excellent. In South Korea, a higher proportion of respondents also rated their health statuses at very good (about 30.4%); 9.1% reported poor health, 14.7% reported fair health, 24.4% rated their health statuses as good, and 21.3% rated their health as excellent. In Japan, most respondents rated their health statuses as good (about 51.5%); 3.9% respondents reported poor health status, 24.7% reported fair health, 16.7% reported very good health, and 3.2% reported excellent health.

For the built environment index, Japan has the highest mean score among the three countries, 3.80 with 0.76 standard deviation, followed by South Korea (3.65 with 0.99 standard deviation) and China (3.13 with 0.89 standard deviation). In terms of the physical environment index, Japan has the highest mean score among the three countries, 3.14 with 0.65 standard deviation, followed by China (2.93 with 0.75 standard deviation) and South Korea (2.64 with 0.69 standard deviation). As for the social environment index, China has the highest average score, 3.91 with 0.73 standard deviation, followed by Japan (3.56 with 0.77 standard deviation) and South Korea (3.19 with 0.96 standard deviation).

For the control variables, the results show that a majority of respondents are from urban areas. The average age is highest in Japan (mean=52), and it is similar for South Korea and China (mean=45). For Chinese respondents, 83.3% were married, 5.5% were widowed, 1.9% were divorced, and 9.3% were never married. In Japan, 68.2% respondents were married, 8.8% were widowed, 3.7% were divorced, and 19.3% were never married. In South Korea, 64.1% respondents were married, 8.1% were widowed, 4.5% were divorced, and 23.3% were never married. The average years of education was highest in Japan (mean=12.67) and lowest in China (mean=8.35). Because household income was recoded into quartiles separately for each country, the percentage distribution should be similar for the three countries. However, because the cut-points used were not precise and the proportion of missing cases varied, we see some differences in the percentage distributions. China had the highest proportion of respondents who were employed full time (58.8%) while South Korea had the highest proportion of respondents who were not working (40.2%). Only a small portion reported that they had part-time jobs. In this study, a higher proportion of respondents were females and this was the only variable which did not significantly differ among the three countries.

(Table 3 about here)

Bivariate Correlations among all the Variables

Table 4 shows the bivariate correlations among dependent, independent and control variables in this study. This correlation matrix is performed to identify the covariates, and more importantly, to check for possible multicollinearity issue in this study. Multicollinearity occurs when some of the variables are highly correlated with one another, which could greatly influence estimate coefficients, standard errors and make the results unreliable. According to the matrix, no serious multicollinearity issues are detected.

The following correlations between neighborhood environments and self-rated health are observed from Table 4: (1) There is no significant correlation between neighborhood built environment and self-rated health. (2) Neighborhood physical environment is negatively associated with self-rated health. Respondents who rate lower scores on physical environment are more likely to report better health statuses. (3) Social environment is positively associated with self-rated health. Respondents who rate higher scores on the quality of social environment also tend to report better health statuses. These results do not control for socioeconomic and demographic variables and thus could be spurious.

(Table 4 about here)

Effects of Neighborhood Environments on Self-Rated Health in China, Japan and South Korea

Table 5 shows results from the four ordinal regression models of neighborhood environment effects on self-rated health. To get a better sense of whether these effects would differ by country, models were estimated separately for China, Japan and South Korea. According to the results, all four models for China, Japan and South Korea are reasonable models for predicting the effect of neighborhood environment on self-rated health as indicated by each model's Chi-square statistic and Pseudo R-square. Approximately 23.4% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood built environment and all the control variables in South Korea, followed by China (20.9%) and Japan (12.0%). Approximately 23.3% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood physical environment and all the control variables in South Korea, followed by China (21.0%) and Japan (11.9%). Approximately 24.4% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood social environment and all the control variables in South Korea, followed by China (20.8%) and Japan (13.7%). Finally, approximately 24.7% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood built, physical, social environment and all the control variables in South Korea, followed by China (21.5%) and Japan (14.2%).

In Model 1, only the effect of built environment on self-rated health was tested. After controlling for socioeconomic and demographic covariates, built environment shows significant positive effect on self-rated health in all three countries. One-point increase in the built environment index is associated with 31% increase in the likelihood of reporting better health in Japan, followed by South Korea (16%) and China (14%). Besides the built environment, some SES indicators are also significant in Model 1. For example, one-year increase in respondent's age is associated with 4% decrease in the likelihood of reporting better health, controlling for built environment and other SES indicators in China. However, the effect of age in Japan and South Korea is slightly less (about 3%). Respondent's years of schooling is another influential factor for self-rated health in China, Japan and South Korea. One-year increase in respondent's years of schooling is associated with 3%, 4% and 8% increase in the likelihood of reporting better health in China, Japan and South Korea, respectively.

Household income is also an influential indicator for self-rated health. Respondents who are at the 25%-49% household income quartile in South Korea are 71% more likely to report better health than respondents who have household income below 25%, followed by China (49%) and Japan (25%). Respondents who are at the 50%-74% household income quartile in China are 109% more likely to report better health than respondents who have household income below 25%, followed by South Korea (63%) and Japan (3%). Respondents who are at the 75%-100% household income quartile in China are 108% more likely to report better health than respondents who have household income below 25%, followed by South Korea (86%) and Japan (41%). And respondents who belong to the household income missing category in South Korea are 71% more likely to report better health than respondents who have household income below 25%, followed by China (49%) and Japan (25%). Respondent's gender is another significant predictor, especially in China and South Korea, but not in Japan. Male respondents are 39% more likely to report better health in South Korea than female respondents, followed by China (32%). However, marital status is a strong predictor for self-rated health in Japan. In terms of respondent's work status, full-time employees are 39% and 24% more likely to report better health than those who are not working in China and South Korea, respectively. Part-time employees are 40% and 36% more likely to report better health than those who are not working in China and Japan, respectively. The effects of these socioeconomic and demographic variables vary somewhat when different environmental indices are tested in model 2 and model 3 and when they are tested jointly in model 4, but they do not change substantially.

Model 2 examines whether the neighborhood physical environment has any effect on self-rated health. According to the results, neighborhood physical environment is a significant predictor for self-rated health, especially in Japan, followed by South Korea and China. In Japan, one-point increase in the physical environment index is associated with 35% increase in the likelihood of reporting better health. In South Korea, one-point increase in the physical environment index is associated with 30% increase in the likelihood of reporting better health. Although this is also a significant predictor for self-rated health in China, the effect is quite small, as compared to Japan and South Korea.

Model 3 examines whether the social environment has any effect on self-rated health. After controlling for respondent's SES indicators, the social environment shows significant positive effects on self-rated health in China, Japan and South Korea. In Japan, one-point increase in the social environment index is associated with 55% increase in the likelihood of reporting better health, followed by South Korea (34%) and China (18%).

After separately examining each type of neighborhood environment in each country, model 4 in Table 5 report whether these neighborhood effects still exist or change after adding other neighborhood environments in the same model. According to the results, when built and social environments are controlled at the same level, the effect of physical environment on self-rated health is no longer significant in China. This effect is also attenuated when built environment and social environment are added to the model for Japan and South Korea. After controlling for physical and social environments and SES indicators, the association between built environment and self-rated health is only significant in China. The results show that, one-point increase in the built environment index is associated with 12% increase in the likelihood of reporting better health in China. Consistent with the results from model 1, neighborhood built environment is still positively associated with self-rated health in China. However, this effect is attenuated when the other two types of neighborhood environments are added in the model. Neighborhood social environment is still significant for predicting self-rated health in China, Japan and South Korea, even after controlling for physical and built environments. However, as in model 3, this effect is much stronger in Japan than in China and South Korea.

(Table 5 about here)

Tests of Country Differences in the Effects of Neighborhood Environments on Self-Rated Health

Table 6 shows results from the interaction models of the effects of neighborhood environments on self-rated health. By adding the country variables and interaction terms between country variables and neighborhood environment indices, whether the association between neighborhood environments and self-rated health vary significantly by countries can be determined. According to the results, all four models are reasonable models for predicting the effect of neighborhood environment on self-rated health as indicated by each model's Chi-square statistics and Pseudo R-square. In model 1 (Chi-square=2126.33), approximately 26.3% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood built environment and all the control variables in China, Japan and South Korea. In model 2 (Chi-square=2110.08), approximately 26.1% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood physical environment and all the control variables in China, Japan and South Korea. In model 3 (Chi-square=2171.68), approximately 26.8% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood social environment and all the control variables in China, Japan and South Korea. And in model 4 (Chi-square=2191.29), approximately 27.2% of variance in self-rated health can be explained by the variance in respondent's quality of neighborhood built, physical, social environment and all the control variables in China, Japan and South Korea.

Model 1 examines whether the effect of the built environment on self-rated health vary by countries. After controlling for socioeconomic and demographic covariates, the built environment shows significant positive effects on respondent's self-rated health status in Japan. In Japan, respondents with one-point increase on built environment index are associated with 30% increase in the likelihood of reporting better health. Additionally, a significant interaction effect between living in China and the built environment has been found in this model and the odds ratio of the interaction term is smaller than 1 (OR=.88), which indicates that the effect of neighborhood built environment on self-rated health is weaker in China than in Japan. The interaction term between South Korea and neighborhood built environment is also negative with an odds ratio smaller than 1, but it is not significant which means the effect of neighborhood built environment on self-rated health do not significantly differ between South Korea and Japan.

In model 2, after controlling for socioeconomic and demographic covariates, Chinese respondents are 104% more likely to report better health statuses than respondents from Japan, and South Korean respondents are 188% more likely to report better health statuses as compared to Japanese respondents. The physical environment shows significant positive effects on self-rated health in Japan. In Japan, one-point increase in physical environment index is associated with 34% increase in the likelihood of reporting better health (OR=1.34). Additionally, a significant interaction effect between living in China and the physical environment has been found in this model and the odds ratio of the interaction term is smaller than 1 (OR=.85), which indicates that the effect of neighborhood physical environment on self-rated health is weaker in China than in Japan. The interaction term between South Korea and neighborhood physical environment is also negative, but it is not significant. This would suggest that the effect of neighborhood physical environment on self-rated health does not significantly differ between South Korea and Japan.

Model 3 aims to examine whether the effect of the social environment on self-rated health varies by country. After controlling for socioeconomic and demographic covariates, the social environment shows a significant positive effect on self-rated health in Japan. In Japan, respondents who reported one-point higher on the social environment index are 53% more likely to report better health statuses. Two significant interaction effects between the country variables of China and Korea and social environment were found in this model. The odds ratios of both are below 1, which indicate that the effect of neighborhood social environment on respondent's self-rated health status was stronger in Japan than in China and South Korea.

Model 4 examines whether the effects of neighborhood environments on self-rated health differ by country when adding physical, built and social environments in one model. The main effects show that after controlling for the built and social environments and other covariates, physical environment is positively associated with self-rated health in Japan. In Japan, respondents with one point higher on the physical environment index are 20% more likely to report better health statuses. After controlling for the physical and social environments and other covariates, the quality of the built environment is positively associated with self-rated health. The results show that, in Japan, respondents with one point higher on built environment index are 7% more likely to report better health statuses. This effect, however, is no longer significant. After controlling for the physical and built environments and other covariates, the quality of the social environment is also positively associated with respondent's self-rated health status. In Japan, respondents with one point higher on social environment index are 43% more likely to report better health statuses. In model 4, significant interactions between the country variables and social environment index remain with the odds ratios below 1 after controlling for other types of environments and covariates. This indicates that the effect of social environment on self-rated health is stronger in Japan than in China and South Korea.

(Table 6 about here)

Additional analysis was conducted to see whether the results differ when social environment index does not include the item on safety. The results show that the chi-square statistics and pseudo r-square for models not including neighborhood safety do not change much as compared to the models including neighborhood safety. The effects of social environment on self-rated health vary slightly in China, Japan and South Korea when not including the neighborhood safety in the social environment index, but no substantial change is found in the results.

DISCUSSION AND CONCLUSION

As discussed in the previous sections, the effects of neighborhood environments on self-rated health status have already been extensively studied in both western countries (Roh et al. 2011; Subramanian et al. 2006; Hill, Ross, and Angel 2005; Patel et al. 2003; Ellen, Mijanovich, and Dillman 2001; Hochheiser, Woodward, and Charney 1971) and East Asia (Fujino et al. 2011; Wen et al. 2010; Bassani 2008). However, most studies only focus on one specific country in East Asia. Comparison across countries, especially in China, Japan and South Korea, has received far less attention. This thesis seeks to fill this gap by assessing the effects of neighborhood environments (built, physical and social) on self-rated health status in China, Japan and South Korea, and making comparisons across the three countries.

Consistent with the previous research, a positive association between neighborhood built environment and self-rated health is found separately in China, Japan and South Korea (Wen and Gu 2012; Ellen, Mijanovich, and Dillman 2001), which supports hypothesis 1 in this study. Respondents whose neighborhoods are suitable for exercise, have healthier food choices and more public facilities tend to be more likely to report better health statuses than others. As Miles (2007) argued, adequate physical activity could effectively reduce adverse health outcomes and improve health status in the population. Whether neighborhoods are built with suitability for exercise could greatly influence people's health. Healthier food choices in neighborhoods can be another influential factor for the population's health. People tend to be more likely to be physically and mentally healthier if they live in neighborhoods with healthier food choices (Saelens et al. 2003). In addition, whether neighborhoods are built with adequate public facilities also has an effect on health in China, Japan and South Korea. For example, community parks can increase the likelihood that people take a walk after dinner, which is very important for people in East Asia who lack physical exercise because of tight work schedules.

The results from this study also indicate a positive association between neighborhood physical environment and self-rated health in China, Japan and South Korea, which supports the hypothesis 2. Respondents whose neighborhood are less polluted tend to report better health statuses, even after controlling for socioeconomic and demographic covariates and built and social environments. This is consistent with many previous western and eastern studies related to the neighborhood physical environment and self-rated health. For example, Chinese scholars have found that pollutions have devastating health impacts, reducing population's longevity and health expectations (Wen and Gu 2012). Japanese scholars have also found that air pollution is one of the main causes of asthma in Japan (Shima, Nitta, and Adachi 2003; Imamura, Ide and Yasunaga

2007). Thus, it is no surprise that pollution results in adverse health outcomes. Even worse, the stress and anxiety of living in more polluted areas could also negatively affect self-rated health status (Carpiano and Kimbro 2012; Fujino et al. 2011; Chuang et al. 2007; Burningham and Thrush 2004).

Hypothesis 3 is also supported by the findings of this study, which stated that the quality of neighborhood social environment is positively associated with self-rated health in China, Japan and South Korea. Respondents whose neighborhoods are safer and whose neighbors are more willing to help each other tend to be more likely to report better health statuses. This is also consistent with previous studies. For example, Yen and Syme (1999) stated that social environments are associated with health problems and mortality risks. House, Landis and Umberson (1988) found that people who are less socially integrated are more likely to report poorer health status than those who have more extensive and strong social connections. This can be due to the following reasons: (1) Respondents in safer neighborhoods live with less fear and anxiety, which could lead to a better self-rated health. (2) Safer neighborhoods can reduce the chance that respondents get hurt by street robberies.

However, when adding the three types of neighborhood environments (built, physical and social) in one model, although the three types of neighborhood environments are still positively associated with self-rated health status when controlling for other covariates, these effects have been greatly reduced. This indicates that neighborhood built, physical and social environments may attenuate each other in their relationship with self-rated health in China, Japan and South Korea. It is interesting to note that the effect of social environment remains significant in all three countries even when other types of environment are controlled for, which suggest a more direct and stronger impact of social environment on health.

Consistent with hypothesis 4 in this study, evidence is found for the variation of the effects of neighborhood built environment on self-rated health in China, Japan and South Korea. According to the results, the effect of the neighborhood built environment is stronger in Japan than in China. The variation might be due to the different levels of industrialization and modernization in China, Japan and South Korea. As a developing country, China has achieved rapid industrialization in recent years, increasing the life expectancy and living standards of the Chinese population in general. Therefore, a higher proportion of people recognize the importance of the quality of neighborhood built environment to their health than before (Wang, Chai, and Li 2011). However, with hundreds of millions of people still living below the poverty line in China, there is not a coherent sense about the importance of neighborhood built environment in improving population's health status. Japan and South Korea, as two developed countries, have a relatively long history in developing their economies and improving their populations' living standards. Therefore, the effect of neighborhood built environment on population's health status in Japan and South Korea could be stronger compared to China.

Hypothesis 5 is also supported by the findings of this study. After adding respondents from China, Japan and South Korea in one model and testing the interactions between county variables and physical environment index, there is evidence for the variation of the effects of neighborhood physical environment on self-rated health in

China, Japan and South Korea. According to the results, physical environment has a stronger effect on self-rated health in Japan than in China. This seems contradictory to what we would expect from these countries based on the different levels of pollution in the three countries. This may due to different attitudes towards neighborhood physical environment effect on self-rated health in Japan and China. As a trade-off for rapid economic development, China is faced with an unprecedented environmental threat. Knowing that effective pollution control usually takes long time to accomplish, and is never easy, even though there is a coherent sense of generalized environmental concern among Chinese citizens (Xiao, Dunlap, and Hong 2013), Chinese respondents are more likely to focus on other factors than pollution when they rate their health status. On the other hand, Japan and South Korea, as two developed countries, are more influenced by western countries in developing more advanced and efficient management strategies for air, water and noise pollution. Also, Japan has over 80% of their land area allocated for agriculture and forestry use, which could potentially reduce industrial pollution (Kato, Yokohari, and Brown 1997). Environmental problems in Japan are, therefore, not as severe as in China. Thus, even their overall exposure to pollution is lower than Chinese, Japanese respondents would still consider it to be a serious threat to their health due to their greater awareness towards environmental effects on health.

Consistent with hypothesis 6, the variation of the effects of neighborhood social environment on self-rated health were also found in this study. This effect in Japan is stronger than in China and South Korea, no matter whether neighborhood physical and built environments are controlled or not. This might be explained by the different levels of aging in China, Japan and South Korea. As previous studies stated, since older people usually rely more on social support from neighbors and families, social environments have stronger effects on self-rated health in aging countries (Mathis, Rooks, and Kruger 2015; Gory, Ward, and Sherman 1985). Japan is one of the foremost aged societies in the world, with over 17% of the population being aged 65 and older in 2000 (National Statistical Office 2001). On the other hand, China and South Korea still have a relatively young population composition (Lee and Shinkai 2003). Therefore, the effect of social environment on self-rated health is more likely to be stronger in Japan, as compared to China and South Korea.

Several limitations of this study should be noted. First of all, self-rated health is used as the only health status measure in this study, which is a subjective measure. It does not necessarily represent all dimensions of health status. More measures, such as objective physical and mental health statuses diagnosed by doctors, need to be taken into consideration to avoid such limitations. Second, the cross-sectional design of this study does not allow for the establishment of causality of the associations observed between neighborhood environments and self-rated health. Third, there might be other indicators, which could directly or indirectly influence health status and perceptions of the neighborhood, such as medical conditions, addiction to smoking or drinking, that have not been controlled, possibly affecting the results of this study. Fourth, variables included in physical index only capture part of physical environment dimensions, which neglect the potential influence of other dimensions on self-rated health, such as urban design. Fifth, this study only examined the effects of perceived neighborhood environments.

Although perceptions are most likely to have direct impacts on health, future research that examine both objective and subjective environments may shed more light on the relationship between neighborhood environments and health.

Despite these limitations, this thesis contributes to the research efforts that aim at extending the understanding on the effects of neighborhood environment on population's health status in East Asia, which found that the quality of neighborhood built, physical and social environments are positively associated with population's self-rated health status in China, Japan and South Korea. More importantly, this study has found evidences that these effects actually vary by Country, adding to a growing literature studying the effects of neighborhood environments on self-rated health in cross-national contexts. It is anticipated that findings from this study will provide guide to the general public about more causes of social inequality in health other than socioeconomic characteristics, at the same time, also aid policymakers in making more effective policies to reduce possible adverse effects of neighborhood environment on population's health.

Japan has the strongest neighborhood built, physical and social environment effects on population's self-rated health. To decrease the disparities in health, Japanese government can make the following remediation efforts: First, allocate additional public and private funds for the remediation of currently polluted locations. The remediation efforts must be monitored to ensure that sites located near poor communities and rural communities receive additional funds for remediation, as compared to communities with greater access to economic resources. Second, create more public facilities which can encourage people to have social interactions across social class. This also can promote the development of stronger social networks within urban, suburban and rural communities. At the same time, policies are also needed to regulate the use of new facilities. Overall, remediation efforts need to be made to reduce possible adverse effects of neighborhood environment on population's health. However, government needs to ensure that environmental health promotion interventions at the regional level do not end up sacrificing the well-being of less powerful communities for the benefit of more powerful communities.

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Figure 1. Conceptual Model of the Neighborhood Environment Effects on Self-Rated Health in China, Japan and South Korea.

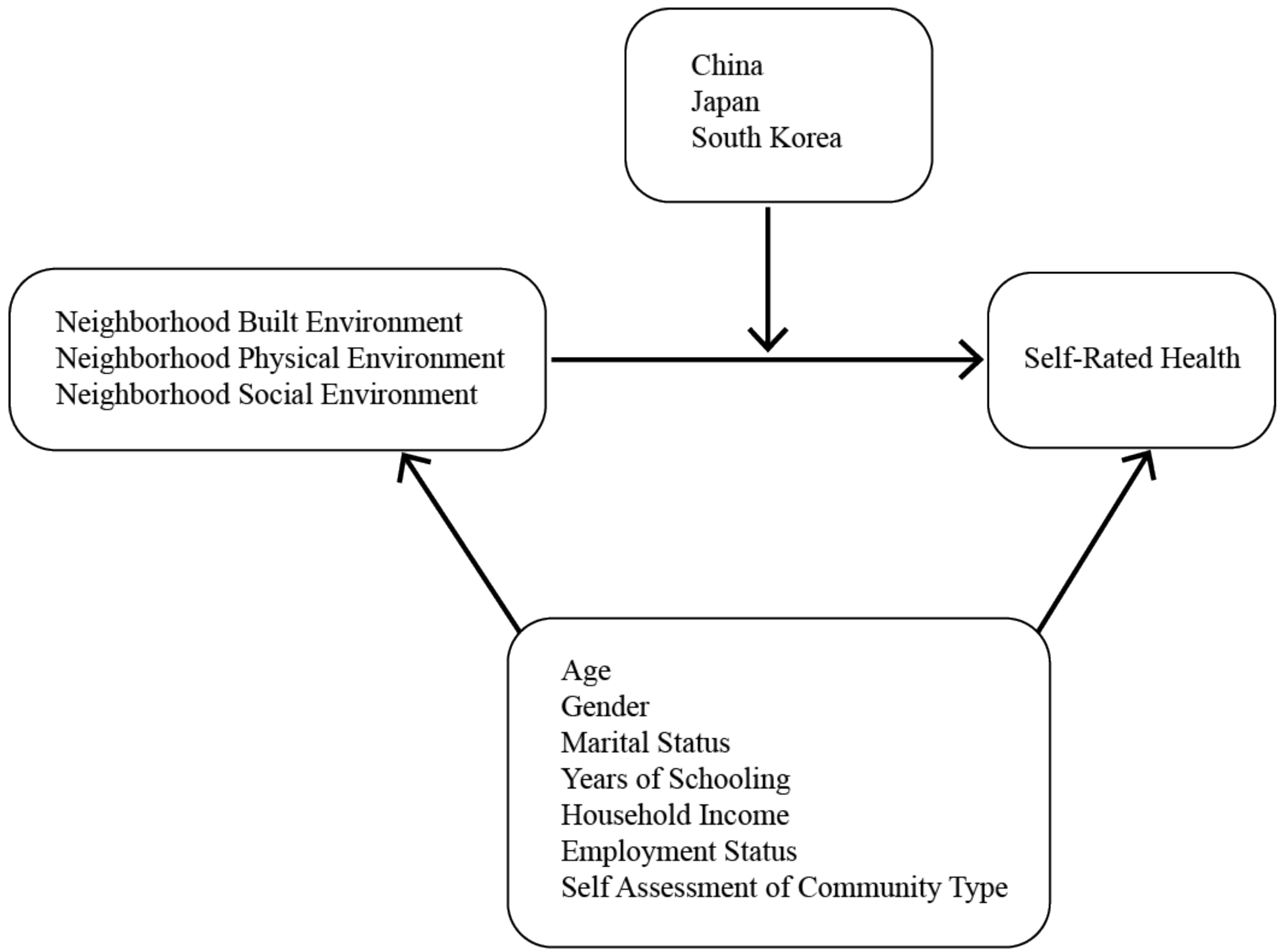

Table 1. Factor Analysis for the Nine Indicators of Neighborhood Environments.

Indicators	Factor Loadings		
	Physical Environment	Social Environment	Built Environment
Neighborhood environment: Suitability for exercise	.080	.026	**.781**
Neighborhood environment: Availability of fresh fruits and or vegetable	.028	.226	**.679**
Neighborhood environment: Adequate public facilities	-.067	-.177	**.783**
How severe is air pollution in the area or R's local residence	**.890**	.081	.024
How severe is water pollution in the area or R's local residence	**.858**	.016	.057
How severe is noise pollution in the area or R's local residence	**.805**	.186	-.004
Neighborhood environment: Safety	.301	**.500**	.393
Neighborhood environment: Mutually concerned for each other	.095	**.921**	.013
Neighborhood environment: Willing to provide assistance	.059	**.916**	-.034

Table 2. Reliability Analysis of Three Indices for Neighborhood Built Environment, Physical Environment and Social Environment.

Index Name	Cronbach's Alpha	N of Items
Built Environment	.632	3
Physical Environment	.823	3
Social Environment	.756	3

Table 3. Descriptive Statistics for Respondents in China (N= 3866), Japan (N= 2496), South Korea (N=1576).

Variables	China			Japan			South Korea			P of Country Difference
	Unweight		Weighted	Unweight		Weighted	Unweight		Weighted	
	N	Mean (STD)/ Percent	Mean (STD)/ Percent	N	Mean (STD)/ Percent	Mean (STD)/ Percent	N	Mean (STD)/ Percent	Mean (STD)/ Percent	
Self-Rated health status										**
Poor	160	4.1%	3.7%	98	3.9%	3.9%	144	9.1%	9.1%	
Fair	547	14.2%	13.3%	627	25.2%	24.7%	232	14.7%	14.7%	
Good	916	23.7%	23.0%	1305	52.4%	51.5%	385	24.4%	24.4%	
Very good	1284	33.3%	34.2%	392	15.7%	16.7%	479	30.4%	30.4%	
Excellent	954	24.7%	25.8%	70	2.8%	3.2%	335	21.3%	21.3%	
Built environment index	3844	3.17(0.90)	3.13(0.89)	2462	3.81(0.75)	3.80(0.76)	1572	3.65(0.99)	3.65(0.99)	**
Physical environment index	3851	2.91(0.75)	2.93(0.75)	2454	3.14(0.65)	3.14(0.65)	1569	2.64(0.69)	2.64(0.69)	**
Social environment index	3840	3.88(.74)	3.91(.73)	2463	3.57(.77)	3.56(.77)	1569	3.19(.96)	3.19(.96)	**
Age	3865	47.13(15.60)	45.08(15.25)	2496	53.70(16.98)	52.02(18.23)	1569	45.20(16.56)	45.20(16.56)	**
Gender										n.s.
Male	1872	48.4%	48.6%	1154	46.2%	48.6%	744	47.2%	47.2%	
Female	1994	51.6%	51.4%	1342	53.8%	51.4%	832	52.8%	52.8%	
Residency										**
Urban	2415	62.5%	59.3%	1619	65.0%	64.5%	1353	86.3%	86.3%	
Rural	1451	37.5%	40.7%	872	35.0%	35.5%	215	13.7%	13.7%	
Marital status										**
Married	3084	80.2%	83.3%	1805	72.3%	68.2%	1007	64.1%	64.1%	
Widowed	279	7.3%	5.5%	203	8.1%	8.8%	127	8.1%	8.1%	
Divorced	110	2.9%	1.9%	99	4.0%	3.7%	71	4.5%	4.5%	
Never married	374	9.7%	9.3%	388	15.6%	19.3%	366	23.3%	23.3%	
Years of schooling	3862	8.50(4.52)	8.35(4.39)	2479	12.63(2.50)	12.67(2.54)	1576	11.89(4.32)	11.89(4.32)	**
Household income										**
Below 25%	774	20%	17.8%	569	22.8%	22.2%	304	19.3%	19.3%	
25%-50%	853	22.1%	22.5%	459	18.4%	18.0%	317	20.1%	20.1%	
50%-75%	862	22.3%	22.5%	311	12.5%	12.4%	407	25.8%	25.8%	
75%-100%	863	22.3%	23.4%	457	18.3%	17.7%	350	22.2%	22.2%	
Income missing value	514	13.3%	13.8%	700	28.0%	29.6%	198	12.6%	12.6%	
Work status										**
Full time	1977	56.7%	58.8%	1011	40.9%	43.4%	774	49.2%	49.2%	
Part time	143	4.1%	4.4%	470	19.0%	17.6%	166	10.6%	10.6%	
Not working	1365	39.2%	36.8%	991	40.1%	39.0%	632	40.2%	40.2%	

** $p<.01$

[The Kruskal-Wallis test was used to test country difference for self-rated health status, physical, built, and social environments, age and years of schooling. The Chi-square test was used for gender, self assessment of community type, marital status and employment status, household income.]

Table 4. Correlation Matrix for all Variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Self-rated Health status	1																
2. Built environment	-.003	1															
3. Physical environment	-.048**	.057**	1														
4. Social environment	.058**	.137**	.280**	1													
5. Age	-.390**	.091**	.145**	.171**	1												
6. Male	.071**	-.003	.001	-.030**	-.009	1											
7. Urban	.072**	.238**	-.265**	-.236**	-.082**	-.012	1										
8. Married	.033**	-.035**	.012	.146**	.138**	.017	-.068**	1									
9. Widowed	-.179**	.012	.069**	.066**	.404**	-.135**	-.046**	-.467**	1								
10. Divorced	-.049**	.014	.003	-.060**	.034**	-.015	.036**	-.300**	-.047**	1							
11. Years of schooling	.126**	.289**	-.132**	-.257**	-.319**	.124**	.345**	-.092**	-.228**	.016	1						
12. Household income 25%-50%	.011	-.061**	.010	.005	-.031**	.023*	-.052**	.077**	-.049**	-.023*	-.084**	1					
13. Household income 50%-75%	.096**	-.009	-.071**	-.002	-.098**	.019	.050**	.080**	-.063**	-.044**	.044**	-.256**	1				
14. Household income 75%-100%	.124**	.092**	-.070**	-.032**	-.095**	.028*	.159**	.077**	-.081**	-.048**	.207**	-.267**	-.262**	1			
15. Income missing value	-.035**	.045**	.028*	-.030**	-.003	-.058**	.014	-.157**	.045**	-.004	.078**	-.242**	-.237**	-.247**	1		
16. Full time	.194**	-.114**	-.007	-.016	-.307**	.245**	-.089**	.095**	-.205**	.000	.081**	.027*	.070**	.104**	-.083**	1	
17. Part time	-.030*	.052**	.004	-.041**	-.003	-.081**	-.015	.007	-.032**	.022	.079**	-.006	-.009	.008	.008	-.348**	1

*P<0.05 **P<0.01.

Note: All results are weighted.

Table 5. Ordinal Regression Models of Neighborhood Effects on Self-Rated Health for Adults in China, Japan and South Korea.

Variables	Model 1 OR(SE)			Model 2 OR(SE)			Model 3 OR(SE)			Model 4 OR(SE)		
	CN	JP	KR	CN	JP	KR	CN	JP	KR	CN	JP	KR
Built environment index	1.14 (.038)**	1.31 (.052)**	1.16 (.048)**							1.12 (.039)**	1.08 (.059)	1.07 (.052)
Physical environment index				1.13 (.044)**	1.35 (.061)**	1.30 (.069)**				1.08 (.045)	1.22 (.063)**	1.19 (.071)*
Social environment index							1.18 (.045)**	1.55 (.053)**	1.34 (.052)**	1.13 (.046)**	1.45 (.061)**	1.25 (.057)**
Age	.96 (.003)**	.97 (.003)**	.97 (.003)**	.96 (.003)**	.97 (.003)**	.97 (.003)**	.96 (.003)**	.96 (.003)**	.96 (.005)**	.96 (.003)**	.96 (.003)**	.96 (.005)**
Male	1.32 (.066)**	1.09 (.085)	1.39 (.100)**	1.34 (.066)**	1.08 (.085)	1.41 (.100)**	1.32 (.066)**	1.10 (.085)	1.43 (.100)**	1.32 (.066)**	1.09 (.086)	1.44 (.101)**
Urban residency	1.03 (.076)	1.02 (.083)	1.07 (.147)	1.14 (.077)	1.08 (.083)	1.22 (.146)	1.14 (.075)	1.21 (.083)	1.27 (.147)	1.11 (.080)	1.13 (.085)	1.26 (.151)
Marital status (ref=Never married)												
Married	.93 (.125)	1.47 (.121)**	.98 (.145)	.94 (.125)	1.52 (.121)**	.98 (.145)	.91 (.125)	1.47 (.121)**	.95 (.145)	.93 (.125)	1.52 (.122)**	.95 (.145)
Widowed	.95 (.205)	2.09 (.203)**	1.05 (.261)	.93 (.204)	1.90 (.203)**	1.02 (.262)	.89 (.205)	1.99 (.203)**	1.04 (.262)	.93 (.206)	1.94 (.205)**	1.03 (.262)
Divorced	.61 (.256)*	.91 (.234)	1.12 (.254)	.67 (.253)	.90 (.235)	1.07 (.254)	.66 (.254)	.96 (.234)	1.11 (.255)	.61 (.257)	.94 (.236)	1.08 (.256)
Years of schooling	1.03 (.009)**	1.04 (.018)*	1.08 (.015)**	1.04 (.009)**	1.04 (.018)*	1.08 (.015)**	1.04 (.009)**	1.05 (.018)**	1.08 (.016)**	1.04 (.009)**	1.05 (.018)*	1.08 (.016)**
Household income (ref=below 25%)												
25%-49%	1.49 (.101)**	1.25 (.128)	1.71 (.166)**	1.46 (.101)**	1.23 (.128)	1.65 (.165)**	1.47 (.101)**	1.26 (.128)	1.75 (.166)**	1.43 (.101)**	1.22 (.130)	1.75 (.166)**
50%-74%	2.09 (.104)**	1.03 (.46)	1.63 (.165)**	2.00 (.104)**	1.03 (.146)	1.56 (.165)**	2.05 (.104)**	0.97 (.147)	1.62 (.166)**	1.99 (.104)**	.96 (.147)	1.61 (.166)**
75%-100%	2.08 (.108)**	1.41 (.136)*	1.86 (.175)**	1.93 (.108)**	1.36 (.135)*	1.80 (.176)**	2.06 (.108)**	1.31 (.136)*	1.85 (.175)**	1.94 (.109)**	1.31 (.137)*	1.81 (.176)**
Income missing value	1.49 (.101)**	1.25 (.128)	1.71 (.166)**	1.46 (.101)**	1.23 (.128)	1.65 (.165)**	1.47 (.101)**	1.26 (.128)	1.75 (.166)**	1.43 (.101)**	1.22 (.130)	1.75 (.166)**
Work status (ref=not working)												
Full time	1.39 (.073)**	1.17 (.107)	1.24 (.107)*	1.37 (.073)**	1.14 (.107)	1.22 (.107)	1.37 (.073)**	1.19 (.106)	1.24 (.108)*	1.40 (.074)**	1.19 (.108)	1.26 (.108)*
Part time	1.40 (.163)*	1.36 (.118)*	1.22 (.162)	1.37 (.161)	1.40 (.119)**	1.23 (.162)	1.40 (.163)*	1.42 (.118)**	1.26 (.163)	1.43 (.166)*	1.44 (.120)**	1.28 (.163)
X^2 (df)	756.86(14)**	279.34(14)**	391.59(14)**	764.90(14)**	276.70 (14)**	390.29(14)**	755.39(14)**	321.99(14)**	409.96(14)**	778.74(16)**	331.00(16)**	413.86(16)**
Pseudo R-Square	.209	.120	.234	.210	.119	.233	.208	.137	.244	.215	.142	.247
N	3485	2472	1572	3485	2472	1572	3485	2472	1572	3485	2472	1572

*P<0.05 **P<0.01.

Note: The results are weighted.

Table 6. Ordinal Regression Models of Neighborhood Effects on Self-Rated Health for Adults in China, Japan and South Korea.

Variables	Model 1 OR(SE)	Model 2 OR(SE)	Model 3 OR(SE)	Model 4 OR(SE)
Built environment index	1.30 (.050)**			1.20 (.060)**
Physical environment index		1.34 (.058)**		1.07 (.056)
Social environment index			1.53 (.049)**	1.43 (.057)**
Age	.97 (.002)**	.97 (.002)**	.96 (.002)**	.96 (.002)**
Male	1.22 (.045)**	1.21 (.045)**	1.23 (.045)**	1.23 (.046)**
Urban residency	1.02 (051)	1.11 (052)*	1.14 (051)*	1.12 (053)*
Marital status (ref=Never married)				
Married	1.14 (.071)	1.16 (.071)*	1.11 (.071)	1.13 (.072)
Widowed	1.31 (.123)*	1.13 (.234)	1.23 (.123)	1.24 (.124)
Divorced	.92 (.140)	.89 (.140)	.94 (.140)	.91 (.141)
Years of schooling	1.07 (.007)**	1.08 (.007)**	1.08 (.007)**	1.07 (.007)**
Household income (ref=below 25%)				
25%-49%	.63 (.074)**	1.39 (.070)**	.61 (.074)**	.64 (.074)**
50%-74%	.87 (.068)*	1.54 (.072)**	.86 (.068)*	.88 (.068)
75%-100%	.96 (.066)	1.64 (.074)**	.94 (.066)	.95 (.067)
Income missing value	.92 (.071)	1.47 (.073)**	.92 (.071)	.92 (.071)
Work status (ref=not working)				
Full time	1.23 (.051)**	1.21 (.051)**	1.23 (.051)**	1.24 (.052)**
Part time	1.33 (.078)**	1.36 (.079)**	1.36 (.078)**	1.39 (.079)**
China	2.04 (.231)**	2.04 (.227)**	2.35 (.250)**	2.51 (.334)**
South Korea	2.74 (.263)**	2.88 (.263)**	1.57 (.242)**	1.48 (.358)**
China*Built environment	.88 (.061)*			.90 (.074)
Korea*Built environment	.94 (.068)			.98 (.093)
China*Physical environment		.85 (.072)*		1.04 (.067)
Korea*Physical environment		.93 (.089)		1.08 (.075)
China*Social environment			.80 (.066)**	.79 (.072)**
Korea*Social environment			.81 (.069)**	.79 (.078)**
X^2 (df)	2126.33 (18)**	2110.08 (18)**	2171.68 (18)**	2191.29 (24)**
Pseudo R-Square	.263	.261	.268	.272
N	7529	7529	7529	7529

*P<0.05 **P<0.01.

Note: the results are weighted.